METHOD AND APPARATUS FOR APPLYING A MULTI-COMPONENT ADHESIVE

BACKGROUND OF THE INVENTION

1. Field of the Invention.

The present invention deals with multi-component adhesives and, in particular, with methods and apparatus for applying such adhesives.

2. Description of the Prior Art.

Various chemically reactive adhesives which are characterized by the occurrence of a chemical reaction during the formation of the adhesive bond are known in the art. A number of these chemically reactive adhesives are multi-component systems such as urea-formaldehyde, phenol-formaldehyde, resorcinol-formaldehyde or resorcinol-phenol-formaldehyde systems. In a resorcinol-phenol-formaldehyde system, for example, a viscous solution of a water soluble, fusible phenol-resorcinol-formaldehyde resin is first made. So that such a resin may be stored for an extended period of time without hardening, the amount of formaldehyde in this resin is limited. When, however, it is desired that an adhesive mix be formed from this resin in preparation for its application, a methylene donor, commonly referred to as a hardener, is added to the resin to cure it to a cross-linked insoluable, infusible state. Commonly used hardeners are liquids such as aqueous formaldehyde solutions or solids such as or hexamethylenetretramine. Solid hardeners are sometimes mixed with liquids to form a slurry and, for definitional purposes, the use herein of the term "liquid hardener" will encompass hardeners which are in a slurry as well as those hardeners which are in a solution.

It is often desirable that the resin and hardeners in a multi-component adhesive be mixed together as soon as possible before application so as to avoid the possibility that premature curing might occur. In U.S. Pat. No. 3,374,987 an apparatus is disclosed in which an adhesive applicator contains an integral device for mixing a liquid resin and a liquid hardener so that application and mixing occur substantially simultaneously. Although this applicator would appear to substantially preclude the possibility of premature curing of the adhesive, certain problems relating to the application of multi-component adhesives still remain to be addressed. Specifically, it is known that changes in temperatures may result in changes in the viscosities of a liquid resin or a liquid hardener. In as much as a precise ratio of resin to hardener may be required to achieve certain desired characteristics in curing conditions or in the adhesive bond, it may be necessary for an operator to make numerous adjustments to the rates at which liquid resins and hardeners are introduced into the mixer-applicator so as to ensure that this precise ratio is maintained during conditions of changing temperature. Additionally, it may also be desired to increase the rate of flow of adhesive from the applicator. In order to achieve such an increase in adhesive flow rate with mixer-applicators heretofore known, it has been necessary for an operator to engage in the time consuming procedure of increasing the rate of flow of the resin and then increasing the hardener flow rate to the exact rate which would allow maintenance of the desired resin to hardener ratio. It is, therefore, the object of the present invention to provide a method and apparatus for applying a multi-component adhesive in which the mixing of liquid resins and liquid hardeners occurs substantially simultaneously with the application of the resulting adhesive and in which a precise resin to hardener ratio is maintained regardless of changes in temperature or in volumetric requirements for the adhesive.

SUMMARY OF THE INVENTION

The present invention is an apparatus for mixing a liquid resin with a liquid hardener to form a multi-component adhesive and then immediately applying this adhesive to a surface to be bonded. Liquid resin and hardener reservoirs are provided and these reservoirs are both connected by means of separate conduit means and pumps to a resin and hardener mixing device which is itself connected to an adjacent applicator head so that the adhesive is applied substantially simultaneously with its mixing. The pumps are powered by separate variable output power sources. Means are provided for sensing the instantaneous speeds of the pumps and separate control means then adjust the output of each of the power sources so that their outputs are proportional to the instantaneous speeds of the pumps to which they are connected. The amounts of resin and hardener inputed to the mixing device will be substantially constant regardless of temperature induced changes in viscocities. Preferably, a master control will also be provided so that pump speed can be lowered or increased simultaneously in the same proportions on both pumps. Thus, adjustments in the overall rate of adhesive production may be effected without having to reset the resin to hardener mix each time such adjustments are made.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is further described in the accompanying drawings in which:

FIG. **1** is a front elevational view of a multi-component adhesive applicator device representing a preferred embodiment of the apparatus of the present invention;

FIG. **2** is an enlarged side elevational view of that part of the apparatus shown in FIG. **1** within Oval II; and

FIG. **3** is a schematic illustration showing the operation of the apparatus shown in FIG. **1**.

DETAILED DESCRIPTION

Referring to FIG. **1**, it will be seen that the applicator of the present invention includes a casing **10** which houses pumping mechanisms which are described below and on which there is an external operator's control panel **12**, the use of which will also be described below. Two conduits **14** and **16** bring resin and hardener respectively from separate external reservoirs (not shown) to the pumping mechanism. Resin and hardener remain separate from each other in the casing **10** and are exited from the casing by means of conduits **18** and **20**.

Referring particularly to FIG. **2**, it will be seen that hoses **18** and **20** are equipped, respectively, with air operated pneumatic valves **22** and **24** and that these hoses both terminate at manifold **26**. Positioned below manifold **26**, there is a pin mix chamber **28** with a static pin barrel which is driven by electric direct current motor **30**. A suitable pin mixer is available from the Martin Sweets Co. located at Louisville, Ky. As is known in the art, the bonding or cure time of the mixed adhesive may be adjusted by making adjustments in the speed of the mixer. After resin and hardener are thoroughly mixed in the desired ratio to form an adhesive, it